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AN ACCOUNT OF A NEW GENUS OF MINUTE PAUROPOD MYRIAPODS.

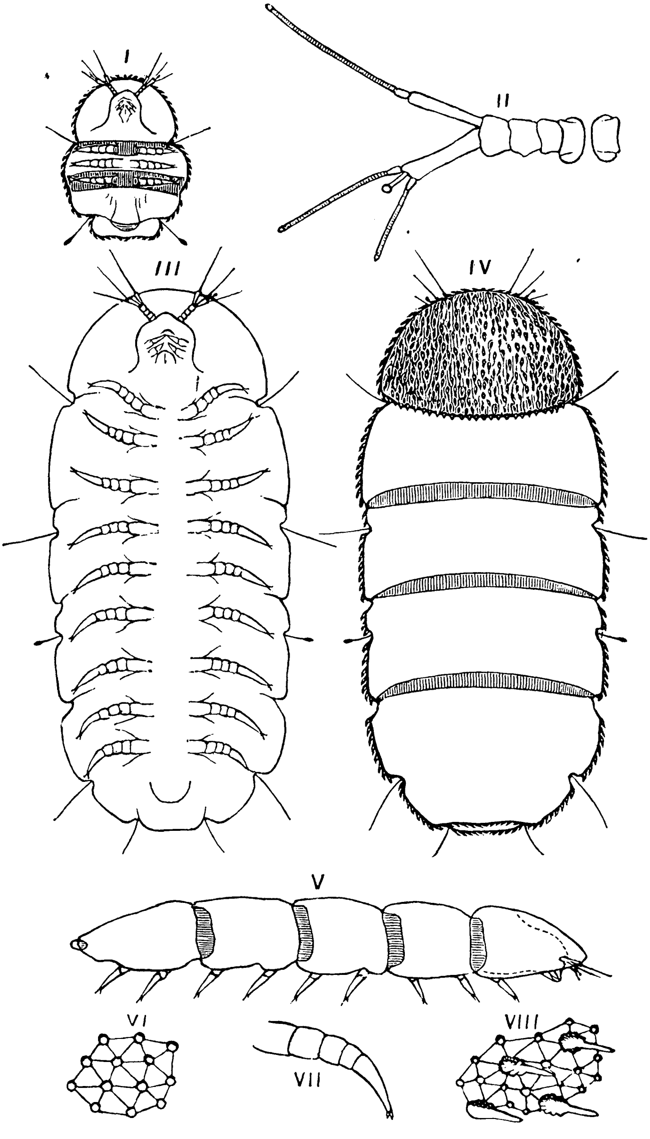
BY JOHN A. RYDER.

IN 1866 Sir John Lubbock first called attention to the remarkable little myriapod which he named *Pauropus* in reference to the fewness of its feet. He discovered the animal in considerable numbers under decaying leaves; he did not consider it exactly social in its habits; not noticing each other's presence, they did not exhibit the extreme ferocity toward each other which characterize some of the large carnivorous myriapods. In specimens of the same genus, however, which I found in Fairmount Park, Philadelphia, in the nests of *Termes flavipes*, upon two occasions, I noticed that when the point of a dissecting needle was carefully brought into contact with them so as to not injure their delicate little bodies, they would throw their heads around towards the offending needle point and "show fight" like the species of the carnivorous genus *Lithobius*. This was not noticed in the specimens of *Eurypauropus* which I am about to describe, and which I kept in confinement for about three months; in fact, the "bustling, active, neat and cleanly" little *Pauropus* is in strong contrast with the former in the two first particulars. The habitat of the new American form is much the same as that of *Pauropus*, being found in moist situations under sticks and decaying vegetable matter, and like it appearing to respire through the skin, so that if placed in a dry atmosphere it soon dies. None of the members of this group attain a large size, *P. huxleyi* being about $\frac{1}{20}$ of an inch long, which is about the size of the new form, whilst *P. pedunculatus* and *lubbockii* are both smaller.

Upon the occasion when Sir John Lubbock first exhibited his then new species at the meeting of the Entomological Society of London, "Mr. Westwood remarked that, with the exception of the genus *Japyx*, described by Mr. Halliday, *Pauropus* was the most interesting addition to the Articulata which had been made for many years." This high degree of interest attaches to the discovery of *Pauropus* on account of the remarkable characters which it presents, and which constitutes it one of those types known to systematists as *synthetic* or *comprehensive*, that is, it embodies characters found in several forms widely removed from each other in the system. In the form of the body and legs the creature recalls the large carnivorous myriapods or centipedes, whilst in the possession of a pulvillus or pad, and a claw on the feet, they resemble in a measure true insects; in their branched antennæ they resemble crustaceans, and in their herbivorous habits they resemble the herbivorous, and in the distribution of the legs they combine characters of both the herbivorous and the carnivorous myriapods.

Sir John believes, after reviewing the opinions of the most distinguished naturalists, that the group must be considered a class having the same systematic value as that of similar subdivisions of the animal kingdom, and in view of the singular assemblage of characters presented by *Pauropus*, he thinks it necessary to erect a new order under the name of *Pauropoda* with a family *Pauropodidæ;* this arrangement would then cause the class to fall into three apparently natural groups.

To the three known species of the order *Pauropoda*, it gives us pleasure to add a fourth, so widely different from all others hitherto described as to leave no doubt as to the propriety of erecting a new genus for its reception. This singular form was discovered by myself in the month of April of the present year, in East Fairmount Park, in company with my friend, Mr. D. S. Holman. Upon that occasion five specimens were obtained, which formed the basis of the description of the genus published in the Proceedings of the Academy of Natural Sciences of Philadelphia shortly afterwards. Not long after, in an excursion with the same gentleman, I found five more specimens in West Fairmount Park, on the west side of the Schuylkill river, perhaps a mile from the first locality, which I succeeded, as stated before, in keeping alive until the middle of July last; having produced young whilst in confinement under such circumstances as to leave no doubt that



EURYPAUROPUS SPINOSUS, Ryder.

they were the parents and consequently that they were adults, having undergone no change meanwhile.

The new form, which in several respects differs in a remarkable degree from *Pauropus*, I have called *Eurypauropus* in reference to its great relative width. The antennæ are five-jointed as in *Pauropus*, but the proportions of the terminal many-jointed filaments are different. These filaments in minute structure are very similar to those of the old genus, being composed of saucer-like disks, which are superimposed in a linear series and united at their centers to each other by delicate but very short pedicels. These like the similar filamentous organs of *Pauropus*, I found could be studied very well with a power of 1000 diameters, as they measure little over $\frac{1}{300}$ of a millimeter in thickness or about $\frac{1}{7500}$ of an inch. The antennæ are inserted close together at the front of the head with a very narrow bridge of chitin intervening between them as shown in Fig. II. The outer branch bears two of the many-jointed filaments, between the bases of which arises a pedicel surmounted by a globular or ovoid semitransparent body with linear sepaliform processes clasping it (but which are not shown in the figure), much as in *Pauropus pedunculatus*.

The body is composed, apparently, of six segments; there is a possibility that the head is composed of two, in which case there would be seven in all, but the most careful focusing failed to reveal more segments than the number stated above. The first or head segment is wide and broadly rounded at its anterior margin, and overhangs the head like a hood or shield with descending borders, from beneath which the ends of the antennæ project forward in a remarkable manner. The head is partly free, a large vacant space appearing on either side and in front of it between it and the free hood-like head shield or segment, the surface of which, as well as that of all the others, is covered with small tubercles and spines, as shown much enlarged in Figs. VI and VIII, whilst its margins, as well as that of all the others are fringed with hooks or spines directed backwards, as shown in Figs. I and IV. There are no other appendages belonging to the head segment except the first pair of legs, which seem a little shorter than those following. Between the first segment and the second there arises on each side a simple hair, which appears to be attached to the second segment, which is more than twice as wide as long, and is overlapped in a peculiar way by the first, as seen in the diagrammatic side view of the animal in Fig. v, where the other segments are seen to overlap each other in succession in a similar manner. The third segment, of nearly similar proportions, has a notch in each lateral margin from which a simple hair arises as in the preceding segment. The fourth segment is very similar to the preceding in proportions, and is notched laterally in the same way, but from the notches on either side there arises a hair ending in a bulbous extremity. The fifth segment is somewhat like the first in form, but has a notch at either side from which there arises a simple hair, and it is truncate behind, the truncated part exceeding very slightly in width the diminutive sixth segment, which is nearly hidden beneath the fifth. On either side of the sixth segment, from a depression, there arises a short hair about half as long as the hair preceding.

I am led to surmise that the notches at the sides of the third, fourth and fifth segments of the adult possibly indicate that these were primitively compound, and in reality represent two segments fused together, which would make nine in all, counting the others as single; this view, though, evidently is not without objection, as there is quite as much ground for a belief that the others are equally as compound. From this point of view the structure of *Eurypauropus* becomes of the highest interest to the morphologist as representing the most extreme point in the reduction of the number of segments in myriapods. It is in fact *Pauropus* with the number of legs characteristic of that genus, but with a number of its segments obliterated by becoming apparently fused together and otherwise modified.

Two pairs of legs are attached to each of the second, third, fourth and fifth segments, which, with the single pair in the first segment, make nine in all. The legs are completely concealed from above, in life, by the lateral expansion of the body segments as in *Pauropus*, but the expansions are not composed simply of chitinous pleural pieces as in the latter, but the thin yielding whitish ventral body wall extends almost to the very margins of the segments. The joints of the legs are composed of thicker rings of chitin than in *Pauropus*, and the only portion of the creature where a thin chitinous body wall is apparent, as in the old genus, is about the head and belly. There is also no evidence of segmentation to be found here, the covering seeming to be continuous from the head to the anal extremity, except at the points where the mouth and vent are situated. The mouth parts seem to be very similar to those of *Pauropus*, though in view of the fact that it has been very difficult to get a satisfactory view of the head portion of the animal, I will not be too explicit in my remarks on this head. The anal opening is guarded below and anteriorly by a semicircular plate of chitin, shown in Fig. III, on the under side of the posterior extremity of the fifth body segment. No evidence of tracheal openings has been observed. Eyes seem to be wanting, indeed the manner in which the first segment overhangs the head, would lead one to suppose that vision would be obstructed, rendering eyes useless; then the remarkable antennary structure may, in a great measure, replace the eyes; and it is difficult to understand the use of the pedunculate hyaline body unless it be auditory. May it not be that the Pauropoda as well as some Diplopods are blind? *Polyxenes*, I am convinced, is provided with very delicate tractile organs at the extremity of the antennæ, and Bode figures minute auditory organs on the head behind its glossy black eyes. It seems to me, therefore, probable, that the multi-articulate, terminal filaments of the antennæ of Pauropods are probably for the most part tactile, whilst the hyaline bodies are wholly or in part auditory in function.

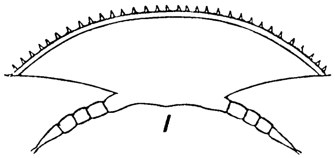
The *larvæ*, of which I possess two specimens, yield no better evidence as to the composite nature of the head segment than the adults; the total number of visible segments in the young seems to be three with uncertain indications of a fourth. The evidence that these larvæ are the offspring of the adults which I had kept in captivity, is complete, having been taken from a chink in a bit of decayed wood into which the adults were repeatedly seen to crawl during the three months of their confinement. Moreover, the chitinous shells of the ova from which the young had escaped, were found in the same cranny. The larval *Eurypauropus*, Fig. I, is exceedingly depressed, more so relatively than the adult, and appearing on this account very much like a young *Cimex*, or bedbug, and having much the same relative proportions, viz: $\frac{1}{63}$ of an inch long by $\frac{1}{83}$ of an inch wide, but altogether smaller. It presents the same peculiar features in the sculpture of the upper surface of its body segments as the adult, but the tubercles and spines are not as strongly developed, but the marginal serratures are well marked. The thickness of the dorsal chitinous pieces of the segments is much less than in the adult, and hence the animal is much more transparent. From each side, and where the head segment joins the succeeding one, there arises a simple hair as in the adult, and from each side posteriorly at the points where the third and the fourth segments join there arises a clubbed hair. The legs are six in number, as is usual in larval myriapods, and appear to be confined entirely to the second segment, and have the same number of joints as those of the adults. The antennæ are of the same form and proportion as in the adult, and have similar terminal appendages. The mouth parts are likewise similar, and the wide free border of the head segment extends forwards and downwards anteriorly beyond the head, the same as in the full grown ones. The young, as would naturally be inferred, are very much paler in color than the old ones, and are of a pale reddish-white or lilac tint, whilst the adults are of an isabeline or pale rusty-red color, the closely set appressed spines on the back giving them a perceptible silky lustre when observed with reflected light; they are much paler below. Their color when viewed with transmitted light, is pale brown, due to the chitin of the body walls. It will be readily seen that the contrast in color between the new form and *Pauropus*, which is almost white, is very great, and sufficient to constitute, with its other features, a very important distinction.

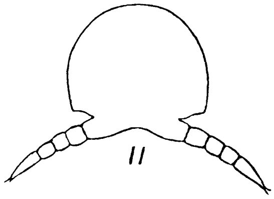
The internal anatomy of the new genus I have not yet been able to work out satisfactorily, owing mainly to the want of an abundance of material wherewith to prosecute the investigation, and also not less on account of the want of proper methods. These latter I think I will soon be able to apply. The entire bulk of the animal is perhaps three times that of *Pauropus*, and is therefore better adapted for anatomical study than the latter.

In habit *Eurypauropus* is much more sluggish than *Pauropus*, and does not scamper away into the nearest crevice like the latter when its haunts are exposed to the light. The specimens which I kept in confinement were placed in a wide-mouthed ounce vial, half filled with moist earth and corked up, into which I had placed some fragments of rotten wood, under which the animals could retreat; in this close place the animals lived for the time I have before stated. In physiognomy they much resemble diminutive sow-bugs, and they also resemble these in the choice of habitat they make, but all of the specimens I have yet collected were taken from the under side of fallen limbs in damp, shady situations on the ground, not under the bark of trees.

Eurypauropus in some respects is a good deal like *Polyxenes*[1] in the shape and superficial ornamentation of its segments, but the dorsal serrate plumes and caudal fascicles of hooked bristles are deciduous in the latter, and may be readily brushed off, which is not the case with the tubercles and spines of the former.

In view of the fact that *Eurypauropus* differs from *Pauropus* in the same way that *Polydesmus* differs from *Julus*, in having the legs concealed by the lateral expansion of the body segments, as shown in the accompanying cut, where Fig. I represents a diagrammatic cross-section of *Eurypauropus* and Fig. II the same of *Pauropus*, as well as in having the head overhung by the anterior, lateral and downward production of the chitinous shield-like first segment, and that it has fewer segments than any other species of Myriapod, I venture to consider it a family under the name of *Eurypauropodidæ*. The following revision of the order becomes accordingly necessary.





PAUROPODA, Lubbock, Trans. Linn. Soc., XXVI, p. 181.

Body composed of 6–10 segments, convex or depressed, with scattered hairs or tubercles and spines. Antennæ five-jointed, bifid, bearing three long, jointed appendages. Nine pairs of legs; feet with a claw and pulvillus. Herbivorous.

I. PAUROPODIDÆ, Lubbock, l. c.

Segments ten, the chitinous annuli of which are circular

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[1] Adverting to *Polyxenes*, I find that its eggs are usually more or less entangled in a felt composed of the caudal bristles, which is, no doubt, a protection against the ravages of the long-snouted mites, and I also find that the singular barbed hooks of these bristles in *P. fasciculatus* Say, are different in form from those of *P. lagurus* of Europe, according to the recent figures of Bode.

Prof. Leidy has recently informed me that he has lately found *P. fasciculatus* at Easton, Pa., which is the fourth locality known to me for this species, making its present distribution extend from Massachusetts to Georgia.

in section with very thin walls and without superficial sculpture. Head not concealed by the forward and lateral production of an anterior segment. Legs not concealed. White. With eyes.

1. *Pauropus huxleyi*, Lubbock, l. c.
Hyaline body of the outer ramus of the antennæ sessile. Length $\frac{1}{20}$ inch. Hab. England and E. Penna.

2. *P. lubbockii*, Packard, Proc. Bos. Soc. Nat. His., XIII, p. 409.
Hyaline body pedunculate but shorter than in the next. Length, .03 inch. Hab. Salem (Packard) and Chelsea (Walker), Mass.

3. *P. pedunculatus*, Lubbock, l. c.
Hyaline body on a long peduncle. Length $\frac{1}{25}$ inch. Hab. England.

II. EURYPAUROPODIDÆ.

Segments six, composed dorsally of a thick plate of light-brown chitin, greatly depressed, three times as wide as high, spinose, tuberculate and reticulate on their upper surfaces; margins serrate. Head concealed by the hood-like anterior production of the first body segment. Legs hidden beneath the lateral expansions of the body segments. Reddish. Without eyes.

1. *Eurypauropus spinosus* Ryder, Proc. Acad. Nat. Sci. Phila., 1879, p. 139, and ibid. p. 164. Length $\frac{1}{20}$ inch. Hab. in Fairmount Park, E. Penna.

The discovery of additional species may now be awaited with some confidence, since the distribution of those already known has been so considerably extended by Dr. Packard and myself. Sharp eyes and patient search in quest of these and kindred minute forms will now reward the student with striking new and little known species much more quickly than by collecting the showy and conspicuous insect fauna of his neighborhood. It was probably the keen-sightedness developed by the experience of Sir John Lubbock in patiently collecting the *Thysanura* that led him to detect and scrutinize *Pauropus*, leading to its recognition as an important new type.

EXPLANATION OF THE PLATE.

FIG. I.—Larva of *Eurypauropus spinosus*, enlarged fifty times.

FIG. II.—Antenna of adult, enlarged two hundred and fifty times.

FIG. III.—Adult from below, enlarged fifty times.

FIG. IV.—Same from above, the sculpture represented only on the first segment, enlarged fifty times.

FIG. V.—Same from the side, enlarged forty-eight times.

FIG. VI.—Tubercles on the upper surface of the segments near their junction, enlarged two hundred and fifty times.

FIG. VII.—Leg, enlarged fifty times.

FIG. VIII.—Spines and tubercles of the back, enlarged two hundred and fifty times.

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MICROSCOPICAL FUNGI INFESTING OUR CEREALS.[1]

BY WM. BARBECK.

I. Ergot.—In examining a rye-field about harvest time we may be pretty sure to find some plants in which, although the ears with their bracts or glumes are apparently developed in a normal way, some of the grains have attained an abnormal size and are of a somewhat blackish color. We have here what is generally known as "Ergot" (botanically *Claviceps purpurea* Tul.), a fungus which is to be found almost exclusively on rye, and which, because of its poisonous effects on animal organisms, is dreaded, particularly in those parts of Northern Europe where rye bread forms the staple daily food.

This fungus shows three distinct stages of development, two of which were well known to former botanists, but were described as separate species belonging to entirely different genera. It is to Tulasne that we owe the discovery of their immediate connection and succession.

Towards June, when the sexual parts have been differentiated, we see a mucous, honey-like substance flowing from out of the bracts of the ear. In examining this "honey-dew" (as it is called by farmers) under a microscope of high power, we behold it swarming with millions of minute oval spores, or conidia, which upon further examination we find to issue from a delicate but complicated mycelium which penetrates the ovary, gradually transforming it into a soft whitish body of an oblong shape with shriveled surface. In this form our fungus was described and recorded by Leveillé as *Spacelia segetum.*

In the course of a few weeks the gelatinous membranes of the mycelium-threads harden and assume a brownish color. Thus the originally soft tissue is transformed into a body of a corky or

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[1] Read before the Biological Section of the Academy of Natural Sciences, Philadelphia.